REMARKS

The withdrawal of claims 1 to 3, 5 to 11 and 41 to 49 is acknowledged. The non-elected claims have been canceled to advance prosecution. Applicants will rely upon the protection afforded by 35 USC 121 for any divisional application that may be filed.

The examined claims have been amended better to distinguish the elected invention over the prior art. New claims 50 to 52 have been added directed to previously unclaimed aspects of the elected invention. The claims before the Examiner for consideration thus are claims 33 to 40 and 50 to 52.

Claim 39 had been rejected under the second paragraph of 35 USC 103 for containing the phrase "or the like." Claim 39 as amended does not contain such language, thus mooting the rejection.

The rejection of claims 30 and 34 under 35 USC 102 as anticipated by Matsumoto et al. '375, if applied to the claims as amended, is respectfully traversed. The liquid crystal display of the present claims is configured so that at least either surface (interface) of the surfaces (the interfaces between the alignment layers and the liquid crystal layer) of the alignment layers on the side of the liquid crystal layer has an irregular configuration

(irregular interface) in a region (pixel display region) between a pixel electrode formed on the first substrate and an opposed electrode formed on the second substrate. The irregular configuration of the alignment layer exists directly above the pixel electrode. An irregular configuration is formed on the surface of the alignment layer, in addition to a rubbing treatment, to make the liquid crystal layer splay-aligned. Having an irregular configuration as claimed provides a structure that when observed locally, each local region of the liquid crystal layer is in a splay alignment but, between the local regions, a tilt angle (an angle with respect to the substrate surface) is different from another tilt angle. Although a rubbing treatment is used in the present invention to make the local regions splay aligned, the irregular configuration of the alignment layer is formed prior to a rubbing treatment; see, for example, Embodiment 4-1 discussed in the specification starting at page 50, line 6. The difference between a layer subjected to a rubbing treatment only and the regularly configured layer in the claimed liquid crystal device is discussed infra.

The liquid crystal display device of the present invention permits a portion of the liquid crystal layer in which the tilt angle changes sharply in adjacent local regions of the layer to have a fast transition in accordance to the voltage applied between the pixel electrode and the opposed electrode. As such, there is a fast transition of the adjacent local regions, with a portion being the center of that fast transition. Therefore, to be able to accomplish a fast transition of the liquid crystal layer, it is preferable that the irregular configuration of the alignment layer exists right above the center of the pixel electrode.

Moreover, the portion in which the tilt angle changes sharply in adjacent local regions is a portion wherein an electric field is concentrated or alleviated. Therefore, a portion of the liquid crystal layer where the tilt angle changes sharply and an electric field is concentrated has an extremely fast transition.

The structure of the instantly claimed liquid crystal display is such that the portion where (1) the tilt angle changes sharply and (2) an electric field is concentrated is always located right above the pixel region, permitting a fast transition of the liquid crystal layer.

Moreover, effects are enhanced when the orientations of the liquid crystal molecules change in the direction of the thickness of the liquid crystal layer more than when the orientations of the liquid crystal molecules change in the surface of the liquid crystal layer. That is to say, the transition of a liquid crystal layer for an OCB mode display can be made extremely fast.

Matsumoto et al. '375 shows only an IPS mode liquid crystal display device. In such a device, it is possible that nonuniformity may be caused by the presence or absence of wiring, electrodes, or thin film transistors (TFTs), making the surface of the laminate layer have an irregular configuration; however, such an irregular configuration caused by nonuniformity of this type does not exist right above the pixel electrode. Moreover, such nonuniformity cannot exist on the center of the pixel electrode in such a structure. Thus, the prior art device is not the device claimed here.

The Examiner asserts, "Since the alignment layers in figure 2 are oriented via a rubbing treatment, their thickness is inherently nonuniform and their surfaces inherently have an irregular configuration." Applicants explain below the difference between

the irregular surface of the alignment layer in the present invention and a surface formed by a rubbing treatment.

When the alignment layer is subjected to a rubbing treatment, fine flaws are formed in a uniform direction on the layer's surface. These uniform-direction fine flaws enable the liquid crystal molecules to be aligned in a predetermined orientation (one orientation determined by a bearing on a plane and a pretilt angle). That is to say, the resulting alignment layer having these fine flaws formed by a rubbing treatment to align liquid crystal molecules in a predetermined orientation is completely different from the alignment layer of the present invention in terms of technical aspects, in which the irregular configuration is provided to form a region having a discontinuous alignment orientation. The effect of promoting the transition of a liquid crystal layer cannot be realized only by forming fine flaws by a rubbing treatment as clearly shown from a comparison of the results of test cell A and test cell R1 in Embodiment 4-1; see Table 1 at page 52 of the specification. The reported transition times are magnitudes different. An unexpected patentable difference is clearly shown.

The Examiner is also referred to Figs. 12 to 16 and their related discussion in the application. The rejection should be withdrawn.

Claim 34 has been amended and now depends from claim 33; the former claim is patentable for the same reasons appearing above. Claim 34 was amended to clarify that the irregular configuration of the alignment layer inherently occurs due to the nonuniform thickness of the alignment layer. See, e.g., Figs. 13 to 15.

The rejection of claims 35 under 35 USC 103 as unpatentable over Matsumoto et al. '375 is respectfully traversed. The Examiner is referred to the arguments above regarding why a rubbing treatment orientation would not give the configuration of the present claims. Thus, claim 35 is patentable also.

The rejections of claim 36 and 37 under 35 USC 103 as unpatentable over Matsumoto et al. '375 are respectfully traversed. The Examiner again is directed to the arguments presented above pointing out how the claim 33 patentably distinguishes over the art. Claims 36 and 37, while reciting more detailed aspects of the invention, both depend from claim 33 and patentably define over the art as well.

Applicants note that the portion of the Office Action directed to the rejection of claim 36 included a discussion of Van Aerle '717, even though the reference was not used as such in the rejection of the claim. Van Aerle '717, even if part of the rejection, does not supply what is missing from Matsumoto et al. '375 as discussed above.

The rejection of claim 38 under 35 USC 102 as unpatentable over Okamoto et al. '445 is also respectfully traversed. Claim 38 depends from claim 33 and the former claim is patentable for the same reasons given above in support of the patentability of claim 33. Applicants have explained above why a rubbing treatment only will not give the irregular alignment layer configuration of the present claims.

Applicants point out that claim 38 has been revised to call for a liquid crystal display device having a structure such that the irregular configuration of the alignment layer inherently occurs due to the irregular configuration of the surface of the substrate on the side of the liquid crystal layer; thus, the irregular configuration of the alignment layer corresponds to that of the substrate on the side of the liquid crystal layer.

The rejection of claim 39 under 35 USC 102 [35 USC 103?] as unpatentable over Okamoto et al. '445 in view of Koike et al. '455 is also respectfully traversed.

This claim is directed to a manufacturing method wherein an irregular configuration is formed on the surface of the alignment layer on the side of the liquid crystal layer by forming the irregular configuration on at least on either surface of the electrodes using a UV usher, an ozone usher, or a UV/ozone usher and forming an alignment layer having an approximately uniform thickness on the electrode. No irregular configuration occurs on the surface of the alignment layer directly by the use of these treatments. Applicants have already explained why a mere rubbing treatment will not give the irregularly configured layer as claimed.

The Examiner asserts that "Koike discloses that treating the surface of the alignment layer with an ozone asher treatment results in a larger pretilt angle." Applicants point out that the treatments specified in claim 39 are not directed to the alignment layer but to the electrode. Thus, the references in combination do not teach or suggest the claimed method. An important feature of

the present invention is that the tilt angle can be varied locally and obtaining only a large pretilt angle does not accomplish what is provided by the present invention.

The rejection of claim 40 under 35 USC 102 [35 USC 103?] as unpatentable over Okamoto et al. '445 further in view of Mishina et al. '999 is also respectfully traversed.

Claim 40 calls for powder and fine particles to be mixed into the alignment layer by applying and baking a printing varnish in which the powder and fine particles are dispersed; this layer is formed on the surfaces of the powder and the fine particles are covered. Thus, the resulting irregular configuration on the surface of the alignment layer on the side of the liquid crystal layer corresponds to how the powder and fine particles are disposed. Applicants pointed out above in their traversal of the rejection of claim 39 why Okamoto et al. '445 does not and cannot provide the irregularly configured layers required by the present claims.

It is asserted in the Office Action that "Mishina et al. discloses that the polyamide of powder form can be dissolved in a solvent to form the material for the alignment film." The powder

after dissolution does not remain in powder form after formation of the alignment film. The claim in contrast specifies that the irregular configuration corresponds to the "disposition of the powder or the fine particles." Accordingly, this claim patentably defines over the references.

New claim 50 depends from claim 33 and sets a level difference of the irregular configuration of the liquid crystal display of the present invention. Support for new claim 50 is found in application Figs. 13 to 16. Normally an alignment layer is formed by rubbing a film having a thickness of about 0.1 μm taking into consideration that a flaw appearing on the surface of alignment layer after a rubbing treatment has a depth of about 0.01 μm, making clear the difference between the flaw and the irregular configuration of the claimed liquid crystal display.

New claim 51 specifies that the largest level of difference is larger than 0.1 but smaller than 0.7 μm. The Examiner is referred to the discussion of Embodiment 4-1 at page 50, lines 23 and 24 where these numbers are shown.

New claim 52 is directed to the liquid crystal display shown in Embodiment 4-5 (see page 59) and in Fig. 16. A liquid display

crystal of this type is primarily made by the method of instant claim 40.

The Examiner is thanked for acknowledging that certified copies of the priority documents were filed in the parent case and for citing references noted in an Information Disclosure Statement.

In view of the foregoing revisions and remarks, it is respectfully submitted that claims 33 to 40 and 50 to 52 are in condition for allowance and a USPTO paper to that effect is earnestly solicited.

The Examiner is requested to telephone the undersigned if additional changes are required prior to allowance.

Respectfully submitted,

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February 27, 2003
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particle which has a diameter smaller than the gap between the substrates and is mixed with and dispersed in the alignment film material.

33. (Twice Amended) A liquid crystal display ~~which comprises a pair of substrates having electrodes and a liquid crystal layer sandwiched between the pair of substrates,~~comprising:

a first substrate having a pixel electrode;

a second substrate having an opposed electrode;

a liquid crystal layer sandwiched between the first substrate and the second substrate and transmitted from a splay alignment to a bend alignment by applying a voltage between the pixel electrode and the opposed electrode;

a first alignment layer provided between the first substrate and the liquid crystal layer; and

a second alignment layer provided between the second substrate and the liquid crystal layer;

~~wherein the liquid crystal layer is oriented in a splay alignment;~~

~~wherein alignment films are stacked on the electrodes; and~~

~~wherein by making the thickness of the alignment films themselves nonuniform, the surfaces of the alignment layers each have an irregular configuration.~~

wherein at least either of the first alignment layer or the second alignment layer is an irregular alignment layer wherein a region of a surface of the irregular alignment layer above the pixel electrode has an irregular configuration, the surface of the first alignment layer being on a side of the liquid crystal layer.

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34. (Twice Amended) A liquid crystal display ~~which comprises a pair of substrates having electrodes and a liquid crystal layer sandwiched between the pair of substrates,~~

~~wherein the liquid crystal layer is oriented in a splay alignment;~~

~~wherein alignment films are stacked on the electrodes; and~~

~~wherein by making the thickness of the electrodes nonuniform, the surfaces of the alignment layers each have an irregular configuration.~~ according to Claim 33,

wherein a region of a surface of the first substrate above the pixel electrode and a region of a surface of the second substrate above the opposed electrode are flat, the surface of the first substrate and the surface of the second substrate being on a side of the liquid crystal layer; and

wherein the irregular alignment layer has a plurality of portions differing in thickness on the flat region, and a pattern of the irregular configuration corresponds to a disposition of the plurality of portions differing in thickness.

35. (Amended) A liquid crystal display according to Claim 33, wherein the ~~alignment layers are~~ irregular alignment layer is formed by letterpress printing.

36. (Amended) A liquid crystal display according to Claim 33, wherein ~~either one of the pair of substrates is an array substrate having pixel electrodes formed thereon, a flattening film is formed on~~

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~~the array substrate, and the flattening film has an irregular configuration.~~ the first substrate is an array substrate further having an electronic circuit;

wherein the first alignment layer is an irregular alignment layer formed such that the irregular configuration is formed on a flattening film for flattening a surface of the array substrate on a side of the liquid crystal layer; and

wherein a pattern of the irregular configuration of the irregular alignment layer is different from a pattern of an irregular configuration of the array substrate on the side of the liquid crystal layer.

37. (Amended) A liquid crystal display according to Claim 33, wherein ~~either of the substrates is a reflective substrate and the reflecting surface of said substrate has an irregular configuration.~~ the first substrate is a reflective substrate having a reflecting surface; and

wherein the reflecting surface has an irregular configuration.

38. (Amended) A liquid crystal display according to Claim 33, wherein ~~a voltage is applied across the electrodes to transit the alignment state of the liquid crystal layer to a bend alignment to perform displaying in the condition after the transition.~~ an electrode on which the irregular alignment layer is provided is an irregular electrode wherein a surface of the irregular electrode on a side of the liquid crystal layer has an irregular configuration, the electrode being either of the pixel electrode of the first substrate or the opposed electrode of the second substrate; and

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wherein a pattern of the irregular configuration of the irregular alignment layer corresponds to the irregular configuration of the irregular electrode.

39. (Twice Amended) A method of manufacturing a liquid crystal display ~~which comprise a pair of substrates including electrodes and a liquid crystal layer sandwiched between the pair of substrates, wherein the liquid crystal layer is oriented in a splay alignment, and wherein the surfaces of alignment layers formed on the surfaces of the electrodes each have an irregular configuration,~~

~~the method including the step of forming the irregular configurations of the electrode surfaces by use of a UV asher, ozone asher, UV/ozone asher or the like.~~ Comprising a first substrate having a pixel electrode, a second substrate having an opposed electrode, a liquid crystal layer sandwiched between the first substrate and the second substrate and transmitted from a splay alignment to a bend alignment by applying a voltage between the pixel electrode and the opposed electrode, a first alignment layer provided between the first substrate and the liquid crystal layer, and a second alignment layer provided between the second substrate and the liquid crystal layer wherein at least either of the first alignment layer or the second alignment layer is an irregular alignment layer wherein a region of a surface of the irregular alignment layer above the pixel electrode has an irregular configuration, the surface of the first alignment layer being on a side of the liquid crystal layer, the method comprising:

forming an electrode irregular configuration on a surface of an

electrode on which the irregular alignment layer is to be provided, the electrode being either of the pixel electrode of the first substrate or the opposed electrode of the second substrate by use of an UV usher, ozone usher, or UV/ozone usher; and

forming the irregular alignment layer having the irregular configuration with a pattern corresponding to a pattern of the electrode irregular configuration by applying a material of the irregular alignment layer on the electrode having the electrode irregular configuration.

40. (Twice Amended) A method of manufacturing a liquid crystal display ~~which has a pair of substrates having electrodes and a liquid crystal layer sandwiched between the pair of substrates;~~

~~wherein the liquid crystal layer is oriented in a splay alignment; and~~

~~wherein the surfaces of alignment layers formed on the surfaces of the electrodes each have an irregular configuration,~~

~~the method comprising:~~

~~a dispersion step of dispersing, beforehand, powder or minute particles into printing varnish used for forming the alignment layers on the surfaces of the electrodes; and~~

~~an alignment layer formation step of forming the alignment layers by applying the varnish onto the surfaces of the electrodes and baking the varnish.~~ comprising a first substrate having a pixel electrode, a second substrate having an opposed electrode, a liquid crystal layer sandwiched between the first substrate and the second

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substrate and transmitted from a splay alignment to a bend alignment by applying a voltage between the pixel electrode and the opposed electrode, a first alignment layer provided between the first substrate and the liquid crystal layer, and a second alignment layer provided between the second substrate and the liquid crystal layer, wherein at least either of the first alignment layer or the second alignment layer is an irregular alignment layer wherein a region of a surface of the irregular alignment layer above the pixel electrode has an irregular configuration, the surface of the first alignment layer being on a side of the liquid crystal layer, the method comprising:

adjusting a material of the irregular alignment layer by dispersing powder or fine particles into a printing varnish; and

forming the irregular alignment layer having the irregular configuration corresponding to a disposition of the powder or the fine particles by applying the material of the irregular alignment on a surface of either of the pixel electrode or the opposed electrode.

41. A liquid crystal display which comprises a pair of substrates having electrodes and a spray-aligned liquid crystal layer sandwiched between the pair of substrates;

wherein a plurality of spacers are placed between the pair of substrates;

wherein the spacers are securely attached to at least either one of the substrates with an adhesive which increases the pretilt angle of liquid crystal molecules within the liquid crystal layer; and

wherein the adhesive is spread over the substrate.

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47. A method of manufacturing a liquid crystal display according to Claim 46, wherein, in the substrate stationary placement step, the substrate is horizontally placed so as to be stationary and the adhesive is spread over a distance approximately no less than the diameter of each spacer, being centered on the spacer.

48. A liquid crystal display manufacturing method according to Claim 46, wherein, in the substrate stationary placement step, the substrate is vertically placed so as to be stationary and the adhesive is spread, in one direction from each spacer, over a distance approximately no less than the radius of the spacer, being centered on the spacer.

49. A method of manufacturing a liquid crystal display which comprises a pair of substrates having electrodes and a spray-aligned liquid crystal layer sandwiched between the pair of substrates,

the method comprising:

a spacer scattering step of scattering spacers onto at least either one of the pair of substrates, the spacers having an adhesive adhered thereto which increases the pretilt angle of liquid crystal molecules within the liquid crystal layer; and

a substrate stationary placement step of sticking the pair of substrates together on which the adhesive is allowed to spread.

50. (New) A liquid crystal display according to Claim 33, wherein, in the irregular configuration of the irregular alignment layer, a largest level difference between a highest portion and a lowest portion is larger than a smallest thickness of the irregular alignment layer but

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smaller than an average thickness of the liquid crystal layer.

51. (New) A liquid crystal display according to Claim 50, wherein the largest level difference is larger than 0.1 um but smaller than 0.7 um.

52. (New) A liquid crystal display according to Claim 33, wherein at least either of the first alignment layer or the second alignment layer comprises powder or fine particles, and a pattern of the irregular configuration corresponds to a disposition of the powder or the fine particles.